Surface Brightness Profiles of Seyfert Galaxies

A. V. Tugay, S. L. Shihov

Taras Shevchenko National University of Kyiv, Glushkova ave., 4, 03127, Kyiv, Ukraine
tugay.anatoliy@gmail.com

We built r-band surface brightness profiles by SDSS data for 16 Seyfert galaxies observed in Crimean Astrophysical Observatory. Obtained profiles can be used for finding more accurate lightcurves for these galaxies.

Introduction

The study of active galactic nuclei (AGN's) is actual branch of modern astrophysics. AGNs have been observed at Crimean Astrophysical Observatory (CrAO) since 1970-th [5]. One of the tasks of AGN study in CrAO is building optical lightcurves and comparing them with X-ray ones[6]. The total list of 58 AGN's observed at CrAO was published in [1],[2],[3] and [4]. Those galaxies were observed on different telescopes with different construction of radiation recievers. In each observation when brightness of AGN is measured, observers take emission from central part of galaxy with some radius. That radius may differ in each observation. To unite such different data correctly we should find surface brightness profiles for studied galaxies. Then one could subtract magnitude from central region, obtain real brightness of point-like nucleus and build precisious lightcurve.

The method of calculations

We used images from Sloan Digital Sky Survey (SDSS). We found SDSS data of 16 Seyfert galaxies from CrAO AGN sample. SDSS has 5 optical bands: u, g, r, i and z. As the galaxy surface brightness must be equal to $25^m/\square''$ at its edge (by definition of galaxy size), we were interested of finding and using galaxy sizes to check or profiles. SDSS collaboration finded isophote sizes (major and minor axes) in r-band for large number of galaxies. That sizes are bounded by isophote of $25^m/\square''$. So we used r-band images for obtaining surface brightness profiles. We calculated counts on images in rings of 1 arcsec width, so background inhomogeneties were averaged. We used ring-like background regions with minor radius equal to major semiaxis of galaxy and major radius depending of position of nearest bright source or end of plate. In the most cases that radius is equal to $120''$ (see Table 1).

Results and conclusions

Examples of surface brightness profiles are shown at Fig. 1. Profiles of disk component up to $25^m/\square''$ are close to linear and active nuclei are more bright. Numerical results are presented in Table 1. In smaller galaxies at radial distance corresponding to major semiaxis we see surface brightness close to $25^m/\square''$. This indicates that performed calculations were correct. For larger galaxies we obtained $25^m/\square''$ at less radial distances. One of possible sources of diversity may be uncertainity of diameter values. At r-band SDSS images background level is 1110 ± 7 counts per pixel (pixel size is $0.4''$, exposition is 54 sec) that corresponds to $18.6^m/\square''$. With such a large background level, a source of 25^m can be detected only when observing of the sky area of at least 20 $\square''$. So error of isophotal diameter can not be less than $5''$. Note that r-band SDSS diameters in NED are given with $0.01''$ accuracy and without errors. For the obtaining of AGN light curves the emission of only the central part of the galaxy should be considered. So we have not performed accurate determination of brightness profiles of outer parts of galaxies. The main result of our work is magnitudes of central part of galaxy image with different radius. This brightness should be subtracted from concrete

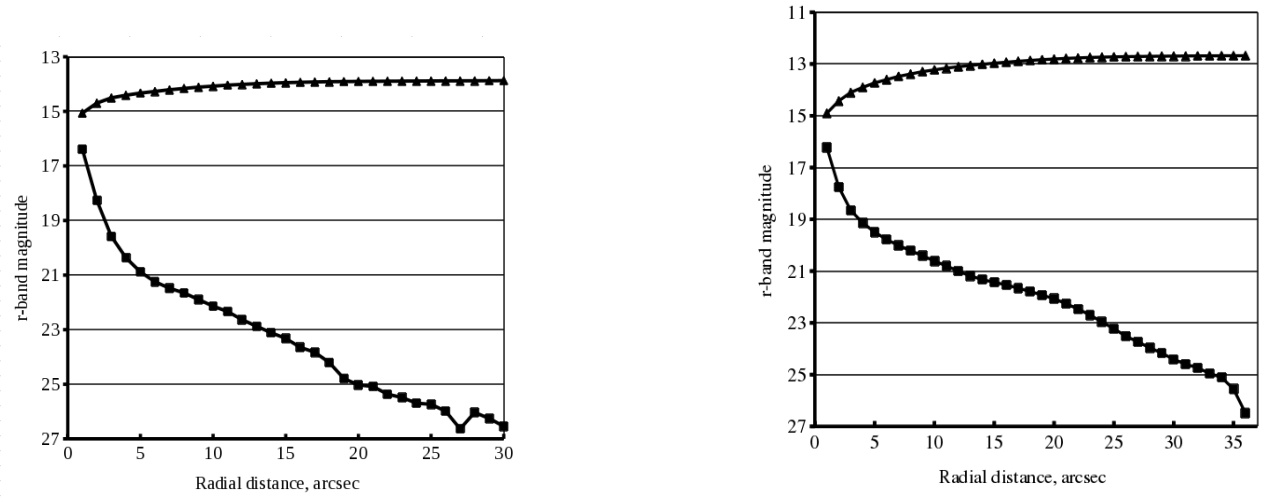

Figure 1: Brightness profiles of Mrk 704 (left) and Mrk 766 (right). Lower graphs - surface brightness profiles, magnitude from square arcsecond. Upper graphs - magnitude in circle of corresponding radius.

variability observation to find the brightness of AGN without the buldge. Taking into account the notes mentioned above we can conclude that obtained profiles can be useful for research of variability of Seyfert galaxies.

Acknowledgement

We would like to thank V.T.Doroshenko for suggesting the problem.

References

[1] Doroshenko V. T., Sergeev S. G., Merkulova N. I., Astrophysics, V. ,48, pp. 156-178 (2005)

[2] Doroshenko V. T., Sergeev S. G., Merkulova N. I., Astrophysics, V. 48, pp. 304-320 (2005)

[3] Doroshenko V. T., Sergeev S. G., Efimov Yu. S., Astrophysics, V. 50, pp. 40-53 (2007)

[4] Doroshenko V. T., Sergeev S. G., Efimov Yu. S., Astrophysics, V. 51, pp. 29-36 (2008)

[5] Sergeev S. G., Doroshenko V. T., Golubinskiy Yu. V., Merkulova N. I., Sergeeva E. A., Ap.J., V. 622, pp. 129-135 (2005)

[6] Sergeev S. G., Doroshenko V. T., Dzyuba S. A. et al., Ap.J., V. 668, pp. 708-720 (2007)

Table 1: Parameters of galaxies. r - r-band SDSS magnitude; a - SDSS r-band major semiaxis in arcseconds; a_{back} - outer radius of background region; m_c - averaged surface brightness in central circle with radius $1''$, in $^m/\square''$; m_a - surface brightness at radial distance a; m_1, m_2 and m_3 - estimated magnitudes within circles of radius 1, 2 and 3 arcseconds correspondingly. Notes: * For 3 galaxies there were no SDSS magnitudes and diameters. We used 2MASS K magnitudes in largest raduis from available: for NGC 3227 - $54.2''$, for NGC 4051 - $35.4''$ and for Ark 120 - $25''$; ** For these galaxies we used large semiaxis from isophote K=$20^m/\square''$

Name	r	a"	a_{back}"	m_c	m_a	m_1	m_2	m_3
NGC 3227	11.30*	92.6**	120	15.41	>26.5	14.10	13.19	12.78
NGC 4151	11.63	102.60	120	16.98	>26.5	15.66	14.47	13.64
NGC 4051	12.03*	102.60**	120	16.04	>26.5	14.73	14.12	13.83
NGC 5548	12.63	39.43	49	16.05	>26.5	14.74	14.15	13.76
Mrk 590	12.87	37.17	56	16.34	>26.5	15.02	14.29	13.86
NGC 7603	12.96	50.37	60	16.98	24.99	15.67	14.70	14.25
Ark 120	12.96*	16.10**	29	15.28	>26.5	13.97	13.34	13.12
Mrk 766	13.01	35.43	120	16.22	25.56	14.90	14.42	14.10
Mrk 79	13.38	45.38	120	17.66	25.25	16.34	15.40	14.87
Mrk 817	13.66	23.45	80	16.47	26.07	15.15	14.53	14.26
Mrk 704	14.04	29.09	112	16.38	26.25	15.07	14.70	14.51
Mrk 382	14.66	23.95	120	17.58	25.52	16.26	15.57	15.28
Mrk 290	14.72	15.42	120	16.86	24.70	15.54	15.12	14.94
Mrk 504	14.87	20.77	76	17.63	25.20	16.31	15.78	15.46
Mrk 110	15.21	25.50	104	18.19	25.60	16.88	16.32	16.05
3C 332	16.78	8.23	29	18.71	25.19	17.39	17.00	16.78